SUPPORT FOR THE AMENDMENTS

Claims 1-23 are cancelled and replaced by new Claims 24-32, which find support as follows:

Claim 24 as in original Claim 10, with the butadiene hydrogenation indicated as occurring first and thereafter isobutene oligomerization catalyst, as in original Claim 21, to specify that butadiene in the olefinic stream is hydrogenated in the first process step to butenes, butanes or C_{5+} oligomers and that isobutene in the second process step is oligomerized to butene oligomers which are dimers and trimers, with support for these latter two limitations being found in paragraph [0026] and [0029], and to add a third process step (c), support found in paragraph [0035];

Claim 25, as in original Claim 3;

Claim 26, as in original Claim 4;

Claim 27, as in original Claim 7;

Claim 28 as in paragraph [0039];

Claim 29, as in original Claim 18;

Claim 30, as in original Claim 19;

Claim 31, as in original Claim 20;

Claim 32, as in original Claim 17.

It is believed there is no possibility of new matter.

REMARKS

Claims 24-32 are in the case.

Applicants have amended the claims to be consistent with the claims in the corresponding PCT application. The references cited in the Written Opinion in said PCT application, as well as the written response thereto, are attached to the present response.

The rejections made in the Official Action mailed 2/7/06 are believed overcome by the above amendments, which present entirely new claims.

Claims 1-3, 6, 7, 9-12, 15-16, 18, and 21 were rejected under §102 and Claims 22 and 23 were rejected under §103, over the patent application to Marchionna et al. (U.S. 2004/0010171).

There are at least three differences between the present claims and the process taught in Marchionna et al. (paragraph [0016] *et seq.* of the reference).

First, the present claims require that butadiene be selectively reacted to form, among other species, C_{5+} oligomers. The reference does not teach this. Rather, butadiene is only hydrogenated. See paragraph [0019] of the reference.

Second, in the reference's step (d) (paragraph [0020], dimerized isobutene is separated from the non-reactants in the stream and not cojoined therewith, whereas in the present Claim 24, the species are all sent in a single stream to the next step, after selective dimerization of isobutene.

Third, there is no step in the reference that fairly suggests step (c) of the present claims.

Accordingly, the reference cannot anticipate nor fairly suggest the present invention.

Claims 4-5, 13-14, and 19 were rejected under §103 over Marchionna et al. in view of Polanek et al. The Polanek et al. reference is directed to a catalyst and the

conditions for selective hydrogenation of butadiene and cannot cure the deficiencies of Marchionna et al.

Claims 8, 17, and 20 were rejected under 103 over Marchionna et al. in view of Sakurada et al. The Sakurada et al. reference is directed to the oligomerization of isobutene and cannot cure the deficiencies of Marchionna et al., set forth above.

Accordingly, in view of the above arguments in conjunction with the amendments, it is respectfully requested that the rejections under §102 and §103 be withdrawn.

There being no further issues, Applicants respectfully urge that the present application is in condition for allowance and early indication of such is earnestly solicited.

Respectfully submitted,

30 May 2006
Date

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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43*bis*.1)

Applicant's or agent's file reference see form PCT/ISA/220 2003B085	Date of mailing *(day/month/year)* see form PCT/ISA/210 (second sheet) **FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2004/019340	17.06.2004	22.06.2003

International Patent Classification (IPC) or both national classification and IPC
B01J35/00, C07C2/12, C07C7/177, C07C7/163, C07C5/05, C10G65/06

Applicant
EXXONMOBIL CHEMICAL PATENTS INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Besselmann, S Telephone No. +49 89 2399-8401

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No. PCT/US2004/019340

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was field, unless otherwise indicated under this item.

   ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ in written format

   ☐ in computer readable form

   c. time of filing/furnishing:

   ☐ contained in the international application as filed.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2004/019340

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	3,4,10,12
	No:	Claims	1,2,5-9,11
Inventive step (IS)	Yes:	Claims	-
	No:	Claims	1-12
Industrial applicability (IA)	Yes:	Claims	1-12
	No:	Claims	-

2. Citations and explanations

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (SEPARATE SHEET)

International application No.
PCT/US2004/019340

Re Item V
Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1, Reference is made to the following documents:
D1: US 2002/002316 A1
D2: US 2003/100811 A1
D3: US-A-4 645 576
D4: US-A-5 227 553

2. DOCUMENT D1

2.1 D1 relates to a process for the production of hydrocarbons with a high octane number. The process involves the selective dimerization of isobutene contained in a hydrocarbon cut having a low isobutene content (linear olefin : isobutene ratio > 3), see paragraph [0001]. The hydrocarbon cut may contain isobutane, isobutene, n-butane and n-butenes (paragraph [0029]; table 2). D1 teaches to eliminate any diolefins from the feed, e.g. by selective hydrogenation paragraph [0031].

The subject-matter of independent claims 1 and 2 is therefore not novel.

2.2 Dependent claims 3-12 do not appear to contain any additional feature which might support novelty and/ or inventive step, the reasons being as follows:

RE claims 3, 4:
A hydrogenation step is taught in D1 (see item 2.1). Hydrogenation catalysts are generally known, see D4 (col. 2, lines 50-55; examples).

RE claim 5:
D1 mentions acid catalysts such as cationic exchange resins, silica-alumina or zeolite as suitable oligomerization catalysts (paragraph [0013]).

RE claims 6-8:
Any diolefins are eliminated from the feed, i.e. prior to the oligomerization step

(paragraph [0031]).

RE claim 9:
In the process of D1, unconverted butenes are recovered (paragraphs [0042], [0043]).

RE claims 10, 11:
The selection of suitable hydrogenation conditions is considered to fall within the common practice of the skilled person. The process conditions used in oligomerization are known from D1 (see claims 8, 9 of D1).

RE claim 12:
Zeolite beta is known from D2 to be suitable for selective isobutylene dimerization (paragraphs [0011] - [0013] of D2).

3. DOCUMENT D3

3.1 D3 also relates to a process for isolating high purity 1-butene. The process involves the oligomerization of isobutene using a silica-alumina catalyst (claim 1 of D3; col. 2, lines 8-33). According to D3, the starting material needs to be deprived of butadiene (col. 2, lines 51-54). D3 does not specify any method for removing butadiene. However, several alternative processes for removing butadiene are known to the skilled person, one of the processes being the selective hydrogenation (see D4, col. 1, lines 42-64 and claim 1).
For these reasons, no inventive step is present in the subject-matter of at least independent claims 1 and 2 in view of D3 in combination with D4.

Re Item VIII
Certain observations on the international application

4. Although claims 1 and 2 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought.

The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

5. Claim 8 defines a process involving a first and a second reactor, i.e. two reactors. This definition is not consistent with the optional feature defining the use of "preferably a single reactor". The subject-matter of claim 8 is therefore unclear, contrary to Art. 6 PCT.

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GERMANY

Via Facsimile 49 89 2399 - 4465

Re: ExxonMobil Chemical Patents, Inc
International Patent Application. No. PCT/US2004/019340
Applicant's Reference No. 2003B085

Dear Sirs,

This reply is submitted in response to the Written Opinion of the International Searching Authority (WO-ISA) dated October 28, 2004. The Demand for Examination under PCT Chapter II is being filed concurrently herewith. A copy is attached. Since the Demand for Examination under Chapter II was properly filed the deadline for response to the WO-ISA is three months from the date mailed or 22 months from the priority date, whichever is later. Thus the deadline for reply to the WO-ISA in this Application is calculated to be January 28, 2005.

1. Claim Amendments

We are submitting several amendments to the claims pending in this PCT application as shown on the attached Amended Claims pages. In particular, the claims are rewritten as follows:

Original Claim 1 is cancelled leaving original Claim 2 as the sole independent claim in the case. This original Claim 2 (new Claim 1) has been rewritten in several respects.

In the first place, original Claim 2 has been rewritten to indicate that the contacting of the olefinic stream with the butadiene hydrogenation catalyst comes first in the claimed process and that this olefinic stream is thereafter contacted with the isobutene oligomerization catalyst. Support for this amendment of original Claim 2 is found in original Claims 6 and 7 which are hereby also cancelled along with original Claim 1.

In the second place, original Claim 2 is also rewritten to specify that butadiene in the olefinic stream is hydrogenated in the first process step to butenes, butanes or C_{5+} oligomers and that isobutene in the second process step is oligomerized to butene oligomers which are dimers and trimers. Support for these amendments to original Claim 2 is found in the description at Page 6, Paragraph [0026] and Page 7, Paragraph [0029], respectively.

In the third place, original Claim 2 is further rewritten to add a third process Step (c) wherein the olefinic stream is sent to a C_4 recovery section wherein oligomers formed in the first two process steps are separated from the olefinic stream. Support for this addition of a third process step is found in the description at Page 8, Paragraph [0035].

Also by the amendments presented, original Claim 8 is rewritten to change "first reactor" and "second reactor" to "first catalyst bed" and "second catalyst bed." Support for this amendment can be found in the description at Page 9, Paragraph [0039].

Also by the amendments presented, original Claim 9 is rewritten editorially in light of the addition to original Claim 2 (from which this Claim 8 depends) of the recitation of a C_4 recovery step.

In light of the several claim cancellations and amendments, the claims have been renumbered and their dependencies changed. A clean copy of such amended and renumbered claims is set forth on replacement claims Pages 12-13 submitted herewith.

2. Novelty

In the Written Opinion, the Examiner indicates that original Claims 1 and 2 and certain other claims dependent therefrom are allegedly not novel in light of the D1 reference (U.S. Patent Publication No. 2002/002316). The D1 publication discloses a process for the production of hydrocarbon fuels having a high octane number by selectively dimerizing isobutene in a hydrocarbon cut containing relatively large amount of n-butenes. Since D1 also indicates that "diolefins" in the hydrocarbon cut "should be eliminated by means of typical removal treatment (for example extractions or selective hydrogenations)", the Examiner has concluded that D1 teaches all of the elements of Claims 1 and 2 of the present PCT case. Reconsideration of this position on the novelty of original Claims 1 and 2 (now consolidated into a new Claim 1), and the selected claims dependent therefrom, is respectfully requested in light of the claim amendments and remarks made herein.

In the first place, the focus of the D1 process is not the cleanup of an olefin stream to provide feedstocks containing linear butenes and low levels of isobutene impurities. Rather the purpose of the "selective" oligomerization of isobutene in the C_4 fraction in D1 is to produce a reaction product which is selectively high in the isobutene dimer, as opposed to the C_{12} isobutene trimer and heavier isobutene oligomers. The Example 1 of D1 in fact converts only 85% of the isobutene in a hydrocarbon stream which contains 11% isobutene, thereby leaving a C_4 fraction which is still too high in isobutene content for many commercial process wherein linear butene-containing feedstocks are to be used. Further, the C_4 fraction from which the dimerized and oligomerized iso-butene materials are removed, contains both n-butenes and n-butanes in unspecified amounts. Such a "purified" stream is then partially recycled in order to provide the requisite n-butene content and relatively high ratio to isobutene in the feed to the oligomerization reactor.

In the second place, with respect to the nature of the feed to the D1 oligomerization reactor, D1 merely says in Paragraph [0031] that "diolefins" should be eliminated. There are, of course, many other diolefins besides butadiene, and D1 does not specify any particular or

specific types of diolefins to be removed. There is simply no disclosure in D1 of a feedstream which specifically contains, as in the present invention, linear butenes, isobutenes and butadienes.

In the third place, Paragraph [0031] in D1 is silent with respect to when in the D1 process the "diolefins" are to be eliminated from streams containing mono-olefins or, for that matter, why such diolefins need to be eliminated. The amended claims of the present application now expressly require removal of butadienes prior to isobutene oligomerization, and there is no specific teaching in D1 of this required sequence.

Finally, Paragraph 0031 of D1 itself notes that diolefins can be eliminated by means of extractions as well as by selective hydrogenation. This teaching does not suggest that one would be any better than the other in the context of the D1 process or in the context of the Applicant's process.

In light of the foregoing considerations, it is submitted that D1 fails to teach all of the specified essential elements now recited in the main claim of the present application. Such an amended main claim (and claims dependent therefrom) are therefore novel over D1.

3. **Inventive Step**

In the Written Opinion, the Examiner urges that the claims in the instant PCT application lack inventive step in view of D3 (US-A-4,645,576), which discloses removal of isobutene from C_4 fractions via oligomerization, in combination with D4 (US-A-5,227,553) which discloses removal of butadienes from C_4 streams by hydrogenation. Reconsideration of this conclusion on inventive step in light of the claim amendments made herein is also respectfully requested.

D3 discloses a process for isolating and recovering 1-butene from butane-butene fractions containing isobutylene, n-butane and isobutane in addition to 1-butene. This is accomplished by oligomerizing isobutylene, but not until the isobutane content of the fraction has been reduced to

less than 0.1% via rectification. D3 does indicate that the starting mixture of C_4 hydrocarbons should be "deprived" of butadiene. But, as the Examiner concedes, D3 discloses no particular method of getting rid of butadiene.

D4 discloses a process for the two stage selective hydrogenation of crude high-butadiene C_4 cuts to provide products higher in butenes. D4 notes that such products, after butadiene content has been reduced, can be further processed. Such further processing possibilities are said to include conversion of isobutene to tert-butyl ether or alcohol, isolation of isobutene, isolation of 1-butene and dimerization of n-butene. But significantly, oligomerization of isobutene to reduce its content in the cut is nowhere mentioned in D4 as a further processing possibility.

So we have a situation here where neither of the applied references suggests its combination with the other. D3 provides no suggestion to remove butadiene by any particular process, much less the specific selective hydrogenation process of D4. D4 provides no suggestion whatever to further treat its butadiene-reduced fraction by means of isobutene oligomerization while suggesting different further treatment procedures instead. Given this situation regarding the relationship of these applied references and the nature of their respective teachings regarding possible additional pre- or post-processing steps, it is respectfully submitted that the Examiner's reference combination of D3 with D4 is one made in hindsight with the benefit of the Applicant's own disclosure. It is urged therefore that the amended claims presented herein are indeed inventive, even in light of the D3 and D4 disclosures.

4. Formal Matters

The Examiner's objection to original Claims 1 and 2 as lacking conciseness has been obviated by canceling the first of these two independent claims.

The Examiner's clarity objection regarding original Claim 8 has been obviated by changing the "first reactor" and "second reactor" terms to "first catalyst bed" and "second catalyst bed."

An annotated version of the original claim set is attached to show the amendments made herein to the claims. Also enclosed are replacement Pages 12-13 setting forth the renumbered and rewritten claims on those pages.

5. **Conclusions**

In view of the foregoing comments, entry of the amendments presented and establishment of a positive Written Opinion with regard to novelty, inventive step, clarity and conciseness in connection with the international examination of this PCT application are respectfully requested.

Very truly yours,

Frank E. Reid
Attorney for the Applicant

Encl.: Amended Claims 1-9 (Annotated)
Replacement claim Pages 12 and 13

Amended Claims

PCT Application No. PCT/US 2004/019340

Please cancel Claims 1, 6 and 7 and rewrite and renumber the remaining claims as follows:

1. (Cancel) ~~A process for selectively removing isobutene and butadiene from a stream, the process comprising contacting the stream with a hydrogenation catalyst to hydrogenate butadiene and an oligomerization catalyst to oligomerize isobutene.~~

~~2.~~ *1.* A process for selectively removing isobutene and butadiene from an olefinic stream further comprising linear butenes, the process comprising:

(a) contacting the olefinic stream under hydrogenation conditions with a hydrogenation catalyst to selectively hydrogenate butadiene in the olefinic stream *to butenes, butanes, or C_{5+} oligomers*, and *thereafter*

(b) contacting the olefinic stream under oligomerization conditions with an oligomerization catalyst to selectively oligomerize isobutene in the olefinic stream *to butene oligomers which are dimers or trimers; and thereafter*

(c) sending said olefinic stream to a C_4 recovery section wherein oligomers formed in Steps (a) and (b) are separated from said olefinic stream.

~~3.~~ *2.* The process of ~~any of~~ the preceding claims wherein said hydrogenation catalyst includes at least one metal selected from Groups 8, 9, 10 and 11 of the Periodic Table of Elements, preferably wherein said at least one metal is selected from nickel, palladium, platinum, rhodium, ruthenium and mixtures thereof.

~~4.~~ *3.* The process of any of the preceding claims wherein said hydrogenation catalyst also includes a porous inorganic oxide support, preferably wherein said porous inorganic oxide support is selected from silica, alumina, zirconia, titania, an aluminophosphate, a clay and a crystalline molecular sieve.

~~5.~~ *4.* The process of any of the preceding claims wherein said oligomerization catalyst includes a solid acid catalyst, preferably wherein said solid acid catalyst is selected from crystalline molecular sieves, substituted silicates, structured polyacids, acidified resins, mixed metal oxides and sulfated zirconia.

6. (Cancel) ~~The process of any of the preceding claims wherein contacting the stream with the hydrogenation catalyst precedes contacting the steam with the oligomerization catalyst.~~

7. (Cancel) ~~The process of any of the preceding claims wherein the contacting with the oligomerization catalyst is conducted after the contacting with the hydrogenation catalyst.~~

~~8.~~ *5.* The process of any of the preceding claims wherein the hydrogenation catalyst is contained in a first ~~reactor~~ ***catalyst bed*** and the oligomerization catalyst is contained in a second ~~reactor~~ ***catalyst bed*** downstream of the first ~~reactor~~ ***catalyst bed***, preferably wherein the hydrogenation catalyst and the oligomerization catalyst are contained in a single reactor.

~~9.~~ *6.* The process of claim ~~2~~ *1* ***wherein in the*** ~~and further including~~ ~~passing the olefinic stream contacted in (b) to~~ a recovery section ~~to recover~~ unconverted linear butenes ***are recovered***.

~~10.~~ *7.* The process of claim ~~2~~ *1* wherein said hydrogenation conditions include a temperature of from about 20°C to about 180°C, a pressure of about 0 to about 500 psig (100 to 3550 kPaa), a liquid hourly space velocity of about 0.1 to about 50 hr-1 and a hydrogen to butadiene molar ratio of about 1 to about 10.

~~11.~~ *8.* The process of claim ~~2~~ *1* wherein said oligomerization conditions include a temperature of about 20°C to about 180°C, a pressure of about 0 to about 500 psig (100 to 3550 kPaa) and a liquid hourly space velocity of about 0.1 to about 50 hr-1.

~~12.~~ 9. The process of claim ~~5~~ 4 wherein said crystalline molecular sieve is selected from faujasites, ZSM-5, ZSM-11, ZSM-12, ZSM-22, ZSM-23, ZSM-34, ZSM-35, ZSM-48, ZSM-50, ZSM-57, mordenite and zeolite beta.

CLAIMS:

1. A process for selectively removing isobutene and butadiene from an olefinic stream further comprising linear butenes, the process comprising:
   (a) contacting the olefinic stream under hydrogenation conditions with a hydrogenation catalyst to selectively hydrogenate butadiene in the olefinic stream to butenes, butanes, or C_{5+} oligomers, and thereafter
   (b) contacting the olefinic stream under oligomerization conditions with an oligomerization catalyst to selectively oligomerize isobutene in the olefinic stream to butene oligomers which are dimers or trimers; and thereafter
   (c) sending said olefinic stream to a C_4 recovery section wherein oligomers formed in Steps (a) and (b) are separated from said olefinic stream.

2. The process of the preceding claim wherein said hydrogenation catalyst includes at least one metal selected from Groups 8, 9, 10 and 11 of the Periodic Table of Elements, preferably wherein said at least one metal is selected from nickel, palladium, platinum, rhodium, ruthenium and mixtures thereof.

3. The process of any of the preceding claims wherein said hydrogenation catalyst also includes a porous inorganic oxide support, preferably wherein said porous inorganic oxide support is selected from silica, alumina, zirconia, titania, an aluminophosphate, a clay and a crystalline molecular sieve.

4. The process of any of the preceding claims wherein said oligomerization catalyst includes a solid acid catalyst, preferably wherein said solid acid catalyst is selected from crystalline molecular sieves, substituted silicates, structured polyacids, acidified resins, mixed metal oxides and sulfated zirconia.

5. The process of any of the preceding claims wherein the hydrogenation catalyst is contained in a first catalyst bed and the oligomerization catalyst is contained in a second catalyst bed downstream of the first preferably wherein the hydrogenation catalyst and the catalyst bed, oligomerization catalyst are contained in a single reactor.

6. The process of claim 1 wherein in the recovery section unconverted linear butenes are recovered.

7. The process of claim 1 wherein said hydrogenation conditions include a temperature of from about 20°C to about 180°C, a pressure of about 0 to about 500 psig (100 to 3550 kPaa), a liquid hourly space velocity of about 0.1 to about 50 hr-1 and a hydrogen to butadiene molar ratio of about 1 to about 10.

8. The process of claim 1 wherein said oligomerization conditions include a temperature of about 20°C to about 180°C, a pressure of about 0 to about 500 psig (100 to 3550 kPaa) and a liquid hourly space velocity of about 0.1 to about 50 hr-1.

9. The process of claim 4 wherein said crystalline molecular sieve is selected from faujasites, ZSM-5, ZSM-11, ZSM-12, ZSM-22, ZSM-23, ZSM-34, ZSM-35, ZSM-48, ZSM-50, ZSM-57, mordenite and zeolite beta.